MANSOURA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRONICS
& ELECTRICAL COMMUNICATIONS
COMMUNICATIONS & INFORMATION ENG.

Electromagnetic Fields
EXAM
July 2011
Time 2 Hours

Attempt the following questions.

1) A- Write Coulomb's law for the force between two electric charges Q1 and Q2 placed at the points $(x_1,y_1,z_1)$ and $(x_2,y_2,z_2)$, respectively.
B- Three equal point charges, Q = 2 nC are arranged in the plane z = 0 at the points a (0,0,0), b(0,0.4,0), and c(0.3,0,0). Distances are in meters. Find:
i) The force acting on each charge
ii) The potential at each point due to charges at the other two points.
iii) The energy stored in the system (13 Marks)

2) A uniform line charge $q_L$ C/m lies along the z axis. Apply Gauss law to derive an expression for the electrostatic field at a point $(\rho,\varphi,z)$ in cylindrical coordinates. If $q_L = 50\mu C/m$, find:
i) The electric flux through the surface of the cylinder $\rho = 0.1$ m of height 0.2m.
ii) The force acting on a point charge q = 2nC placed near the line at the point (0.3m,0,0) (12 Marks)

3) A coaxial transmission line is made of two coaxial conducting cylinders. The inner cylinder has a radius a and the outer one has a radius b. The inner cylinder is at potential U and the outer at potential 0. The space between cylinders is filled with a dielectric of permittivity $\varepsilon$. .
i-Show that the potential V in the space between the cylinders is of the form $V = A \ln r + B$ and find the constants A and B to satisfy the boundary conditions.
ii- Determine the electric field E and the flux density D in the space between the conductors.
iii- Determine the surface charge density on the inner conductor and the total charge per unit length of this conductor.
iv- Determine the capacitance per unit length between the two conductors.
(13 Marks)

4) A- Write Ampere's law in integral form and in point form.
B- Find the magnetic field due to a current I through an infinite wire along the z axis.
C- Two parallel very long wires carry equal and opposite currents I, -I. the distance between the wires is d. Find the magnetic field H at the mid-point between the wires. Show that the field decays away from the two wires.
(12 Marks)